Departure Exclusion Zone (DEZ)

a future concept to enhance runway operations using aircraft derived data

DEZ Concept

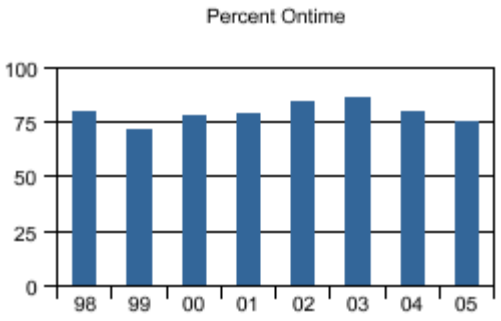
- Addresses Need to Enhance Airport Capacity
  - Improves Wake Avoidance on Departure
  - Reduces Separation Minimums on Departure
- Based On European Mandate for Downlink Aircraft Parameters (DAP)
  - Extends DAP Parameters to Include Met Data – eDAP
  - FMS Offset Departures
- Uses Proven Mode S Technology

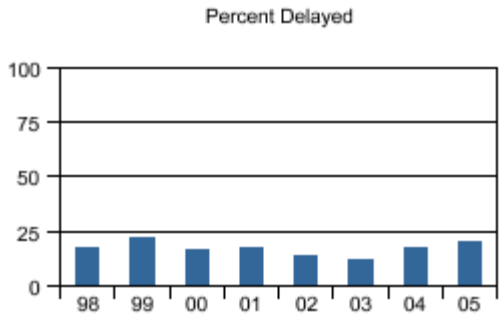
Background

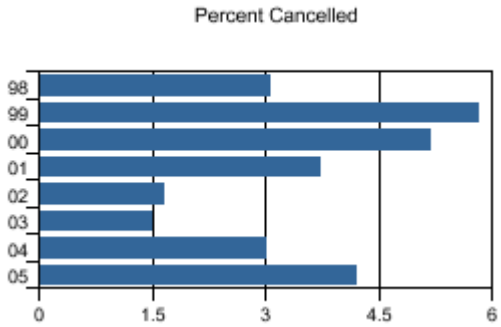
- Today's Delays are Largely Due to Airport Constraints
  - Departure and Arrival Queues Build Delays
  - Wake Avoidance Procedures Are Major Factor
  - Backs Up Traffic in Entire NAS

TranStats

Bureau of Transportation Statistics







Year	Ontime Departures	Ontime (%)	Departure Delays	Delayed (%)	Flights Cancelled	Cancelled (%)	Diverted	Flight Operations
1998	361,128	79.90%	76,993	17.03%	13,880	3.07%	N/A	452,001
1999	326,509	71.95%	100,762	22.20%	26,543	5.85%	N/A	453,814
2000	368,207	78.26%	77,755	16.53%	24,515	5.21%	N/A	470,477
2001	417,177	78.72%	92,872	17.53%	19,891	3.75%	N/A	529,940
2002	369,665	84.72%	59,370	13.61%	7,301	1.67%	N/A	436,336
2003	477,315	86.45%	66,453	12.04%	8,341	1.51%	N/A	552,109
2004	465,304	79.68%	101,072	17.31%	17,611	3.02%	N/A	583,987
2005	447,203	75.17%	122,637	20.61%	25,084	4.22%	N/A	594,924

CP


LGA

LGA, July17

Solution 1 of 1: Data

Table

Rwy Config	Time		Initial Demand		Capacities		Flow		Queue	
	Start	End	Arr	Dep	Arr	Dep	Arr	Dep	Arr	Dep
A22/D13	2130	2145	6	6	8	11	6	6	0	0
A22/D13	2145	2200	13	12	10	10	10	10	3	2
A22/D13	2200	2215	8	8	10	10	10	10	1	0
A22/D13	2215	2230	13	9	11	7	11	7	3	2
A22/D13	2230	2245	11	9	10	10	10	10	4	1
A22/D13	2245	2300	9	8	11	7	11	7	2	2
A22/D13	2300	2315	10	3	11	7	11	3	1	0
A22/D13	2315	2330	9	18	10	10	10	10		
A22/D13	2330	2345	9	6	10	10	9		0	4
Totals			88	79			88		14	19

Solution 1 of 1: Summary

Arrival Delay (min)			Departure Delay (min)			Arrivals delayed by greater than 15 min.	Departures delayed by greater than 15 min.
Total	Average	Max	Total	Average	Max		
363	4.1	10	466	5.9	14	0	0

Back | Back to Main Page

Queue

Arrival	14
Depart	19

ARRIVAL and DEPARTURE DEMAND

ARRIVAL and DEPARTURE DEMAND

KLGA A22/D13 VIS MODE: Alternate

Alternate Capacity Rates	
Arrival	Departure
9	12
11	11
12	8

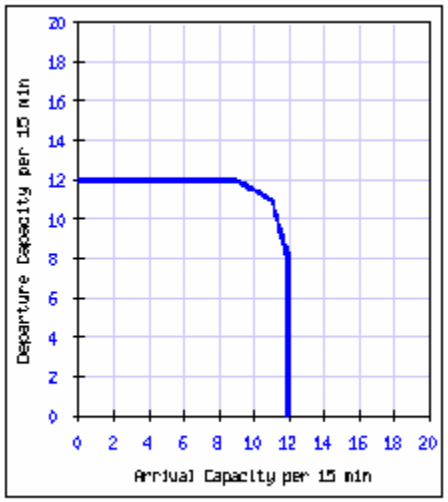
Alternate Capacity Rates	
Arrival	Departure
9	12
11	11
12	8

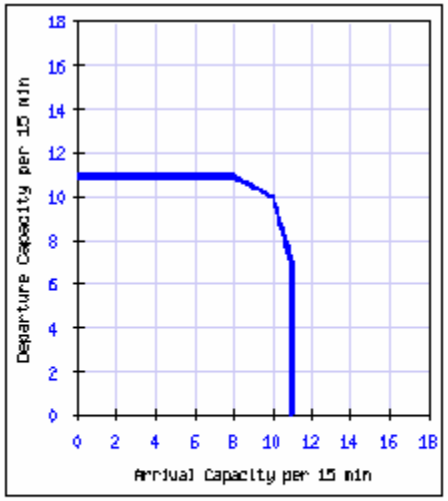
Default Capacity Rates	
Arrival	Departure
8	11
10	10
11	7

Revised Capacity

LGA, July17

Current Capacity





Return to Main Page

REVISED SCHEDULE

For every 15min
One additional A/C

Solution 1 of 1: Data

Table

Rwy Config	Time		Initial Demand		Capacities		Flow		Queue	
	Start	End	Arr	Dep	Arr	Dep	Arr	Dep	Arr	Dep
A22/D13	2130	2145	6	6	11	11	6	6	0	0
A22/D13	2145	2200	13	13	11	11	11	11	2	1
A22/D13	2200	2215	8	8	11	11	10	9	0	0
A22/D13	2215	2230	13	9	12	8	12	8	1	1
A22/D13	2230	2245	11	9	11	11	11	10	1	0
A22/D13	2245	2300	9	8	11	11	10	8	0	0
A22/D13	2300	2315	10	3	12	8	10	3	0	0
A22/D13	2315	2330	9	18	9	12	9	12	0	6
A22/D13	2330	2345	9	6	9	12	9	14	0	0
Totals			88	79			88	79	4	8

Solution 1 of 1: Summary

Arrival Delay (min)			Departure Delay (min)			Arrivals delayed by greater than 15 min.	Departures delayed by greater than 15 min.
Total	Average	Max	Total	Average	Max		
242	1.8	7	266	3.4	9	0	0

Back | Back to Main Page

Queue (Current)

Arrival	14
Depart	19

Queue (New)

Arrival	4
Depart	8

Improvement

Arrival	28%
Depart	42%

REVISED ARRIVAL and DEPARTURE DEMAND

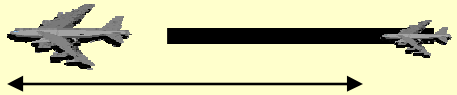
Wake Vortex Capacity Limitations

Arrival

4-6 miles

- **IFR only**
- **Applied behind Heavy, B757, Large aircraft**

Departure



4-6 miles or 2 minutes

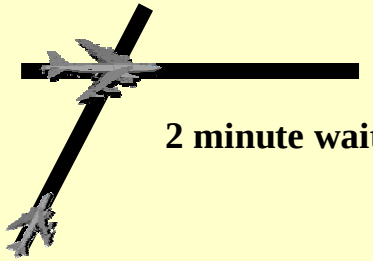
- **All times**
- **Applied behind Heavy or B757 aircraft**

Parallel Runway

4-6 miles

- **Treated as a single runway when separated by < 2,500 ft.**

Intersecting Runways



2 minute wait

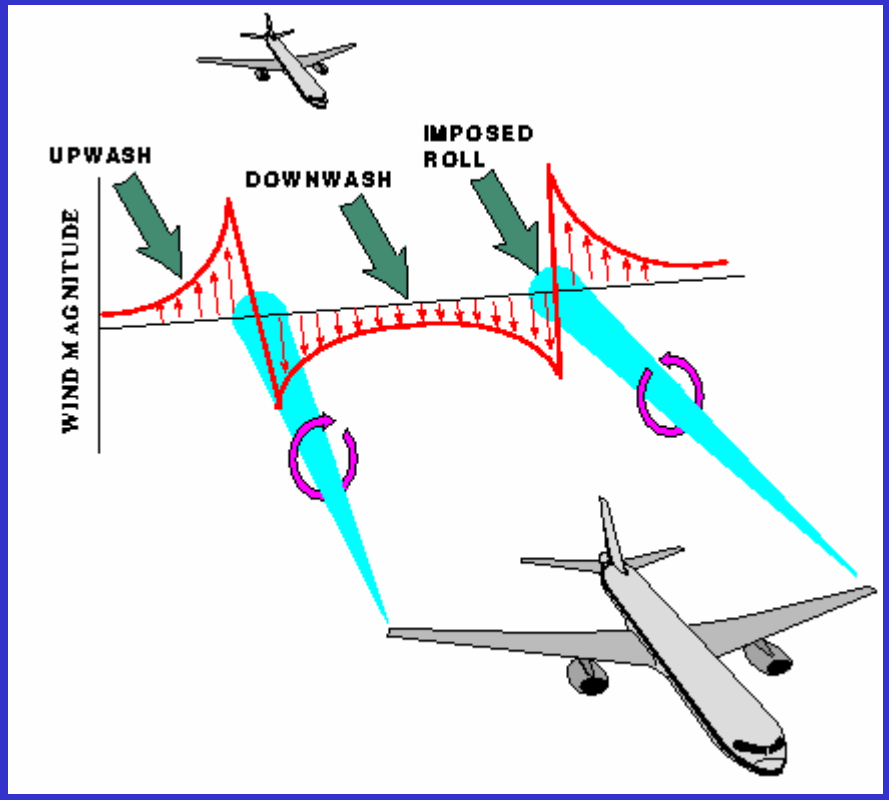
- **When airborne B757 or heavy jet passes intersection.**

Wake Vortex Hazard

Vortex strength for an elliptically loaded wing is:

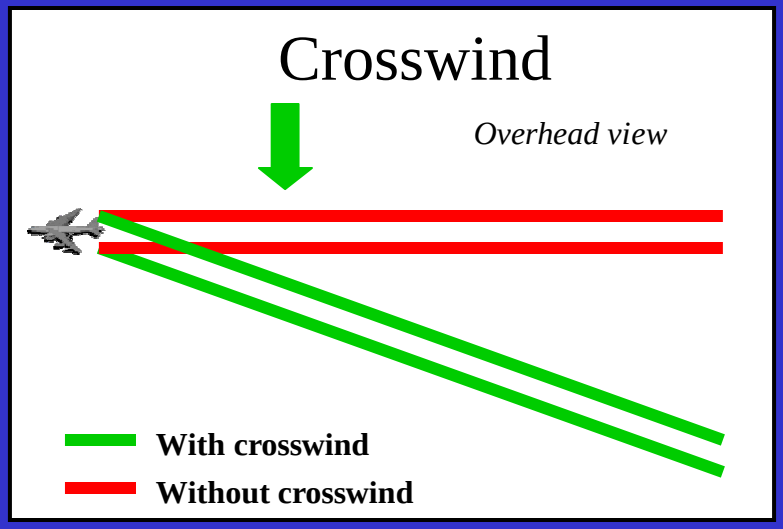
$$\Gamma = 4W / \pi b \rho V$$

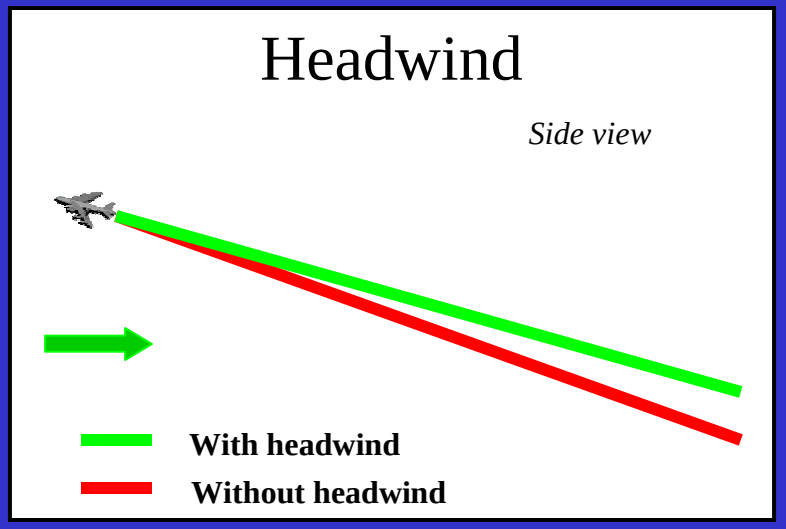
Weight — Wingspan — Air Density — Airspeed

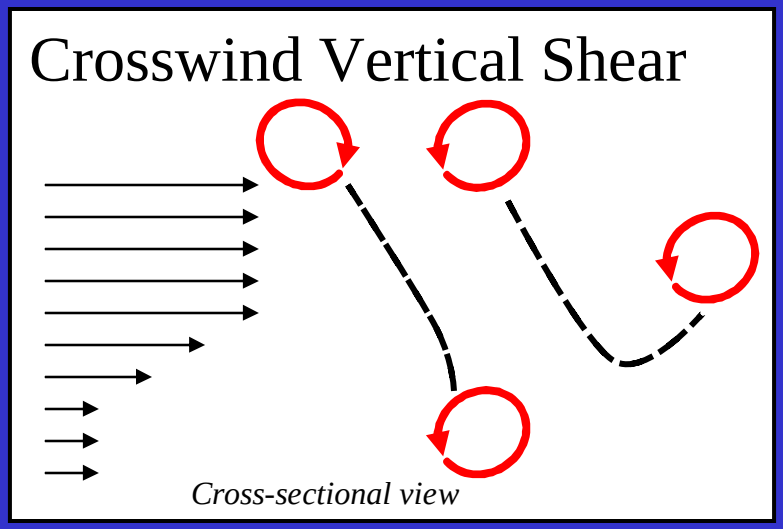


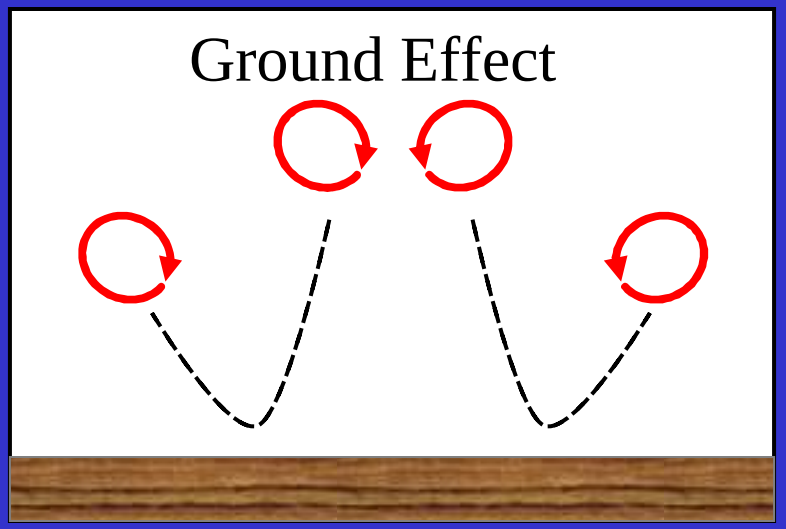
- **Departure initial circulations 10-15% lower than arrival circulations.**
- **Wake encounters are common**

Wake Transport



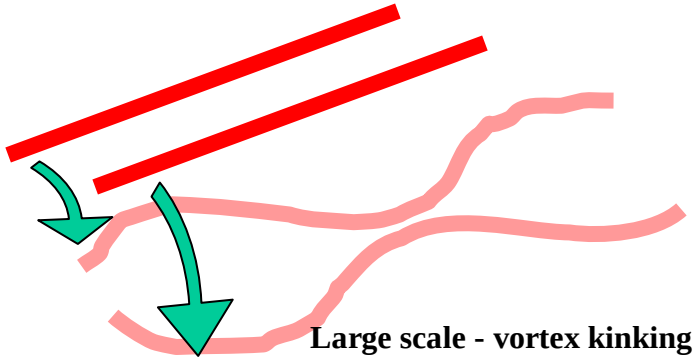






Wake Decay

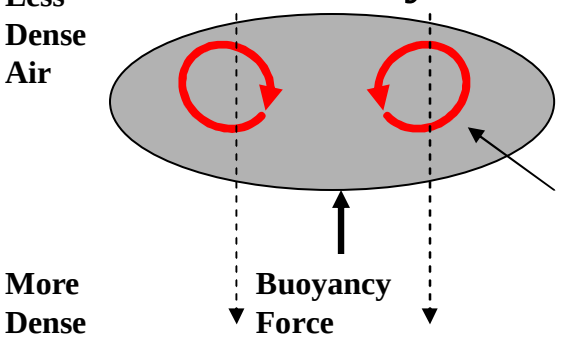
Turbulence



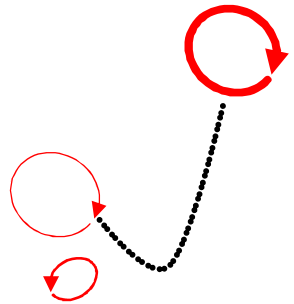
Large scale - vortex kinking

Small scale - breakup

Stability

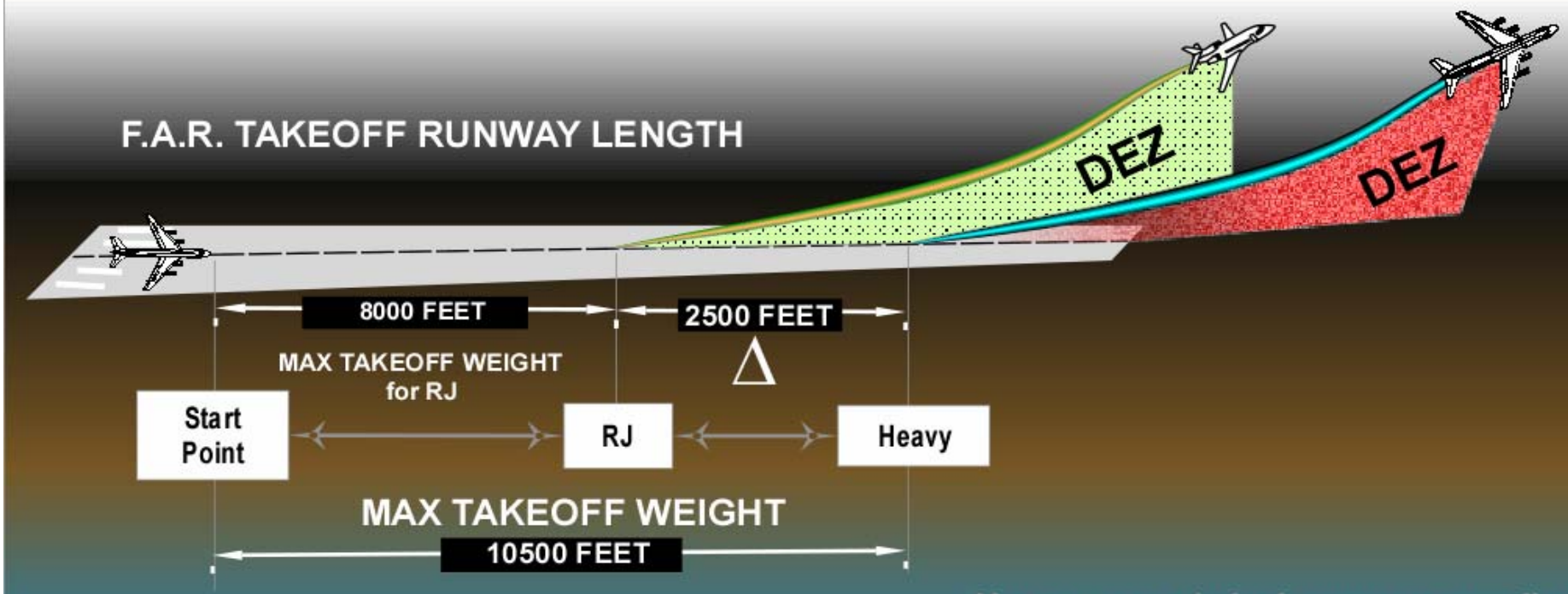


Ground

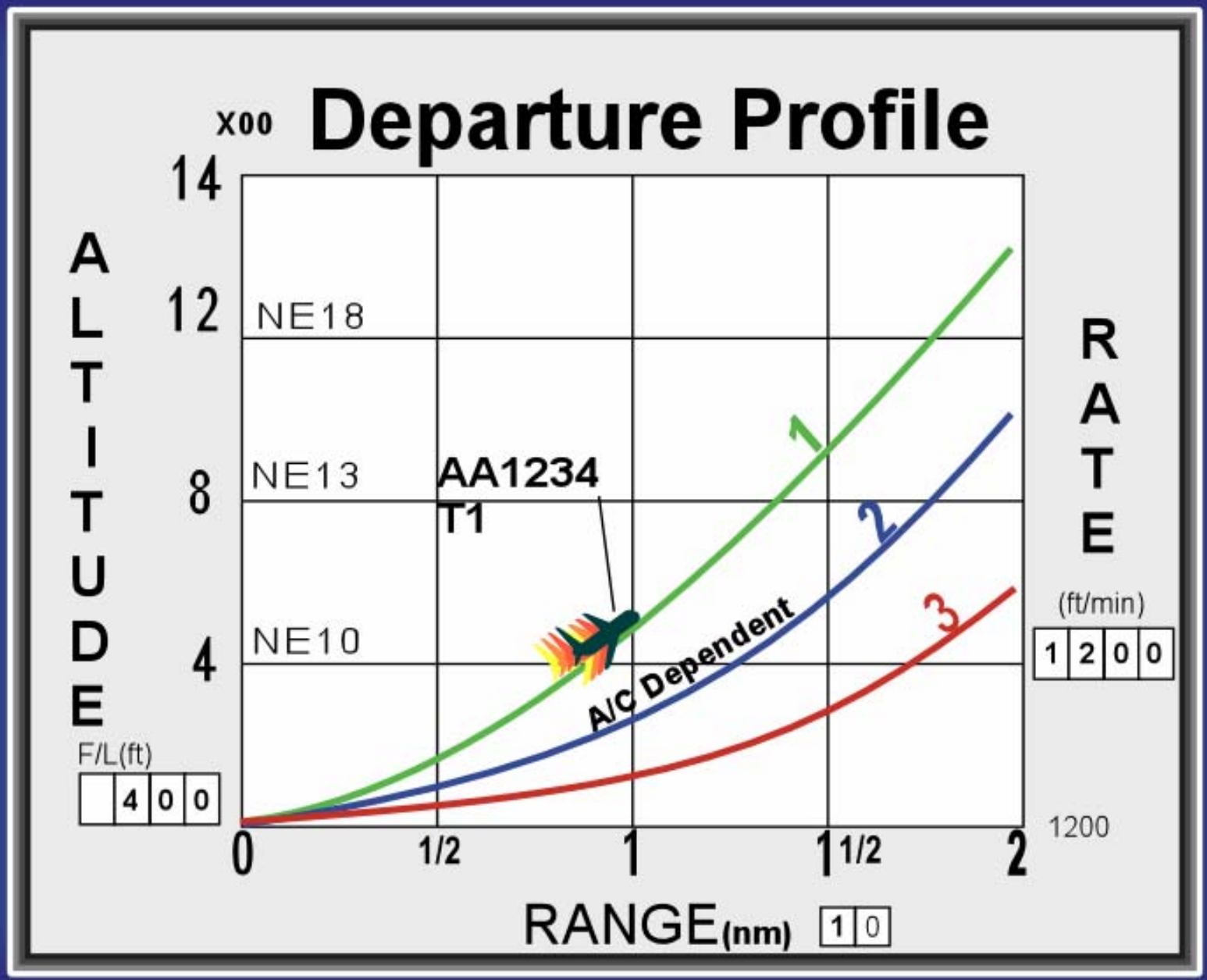


Ground friction speeds vortex decay

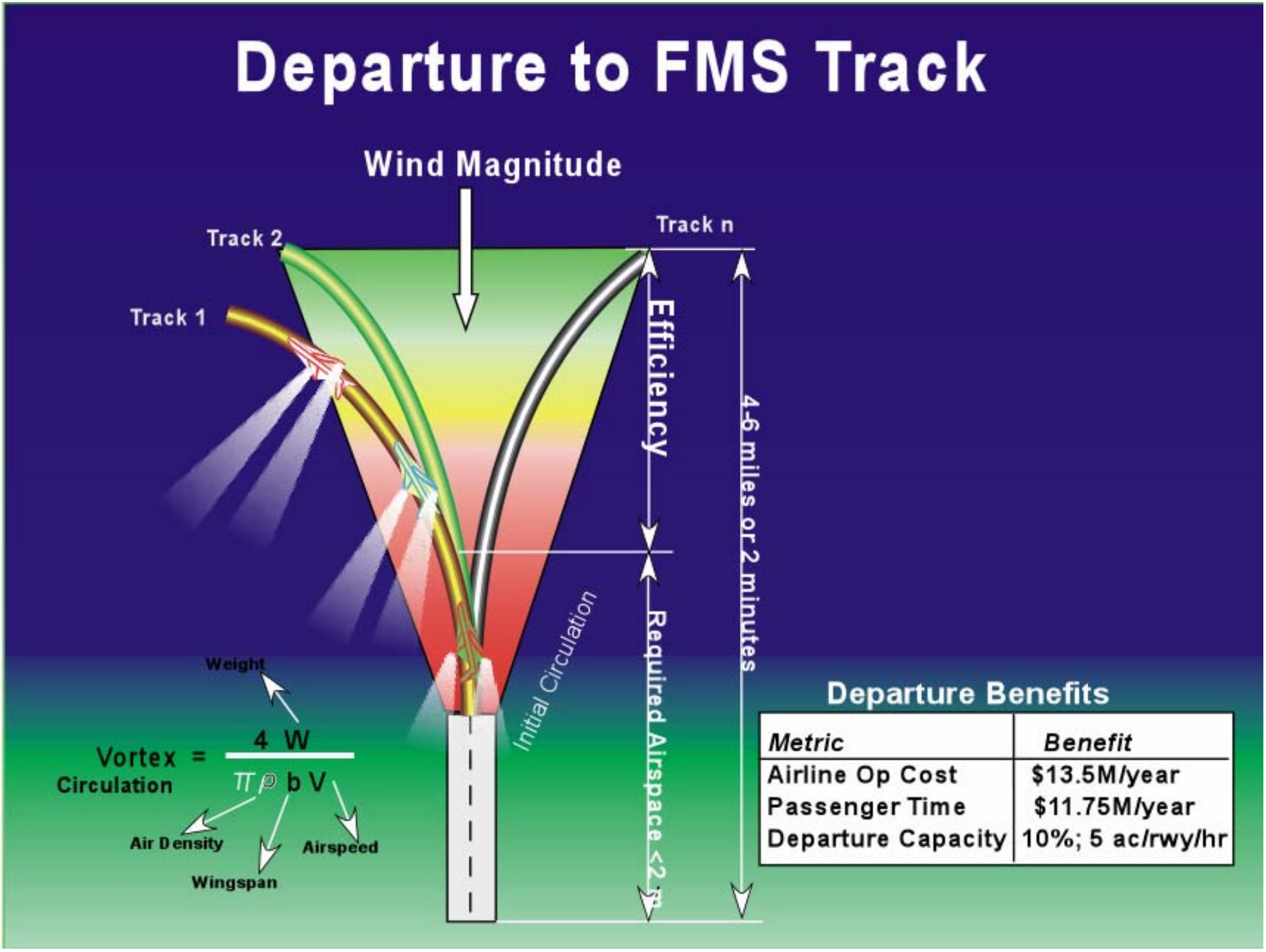
TAKEOFF RUNWAY LENGTH REQUIREMENT
for
RJ vs. HEAVY



Notes: zero (wind, runway gradient)
dry runway surface

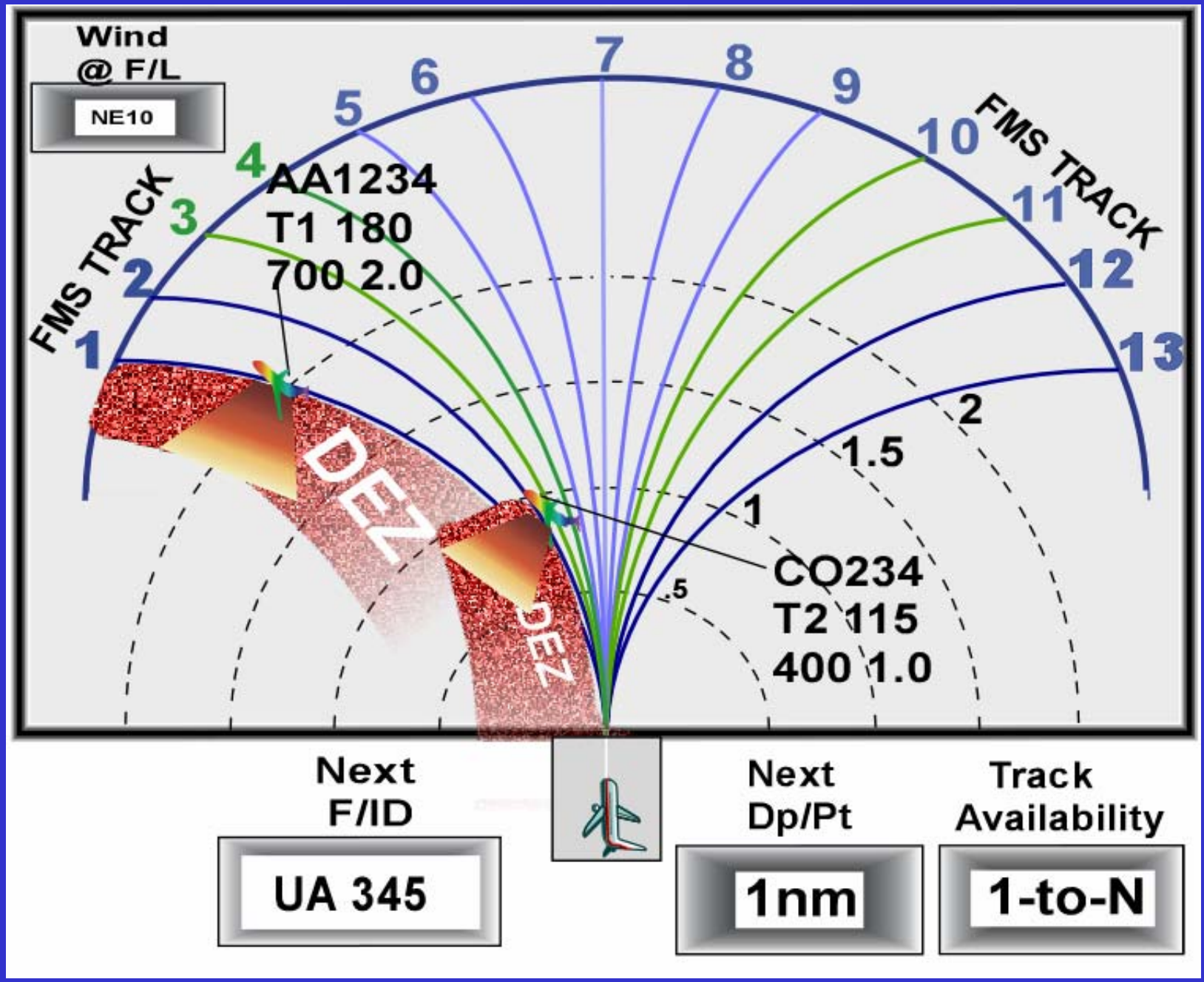

XOO
Departure Profile
ALTITUDE
F/L(ft)
4 0 0
14
12
8
4
NE18
NE13
NE10
AA1234
T1
1
2
3
A/C Dependent
RATE
(ft/min)
1 2 0 0
1200
0
1/2
1
1 1/2
2
RANGE(nm)
1 0

Departure to FMS Track

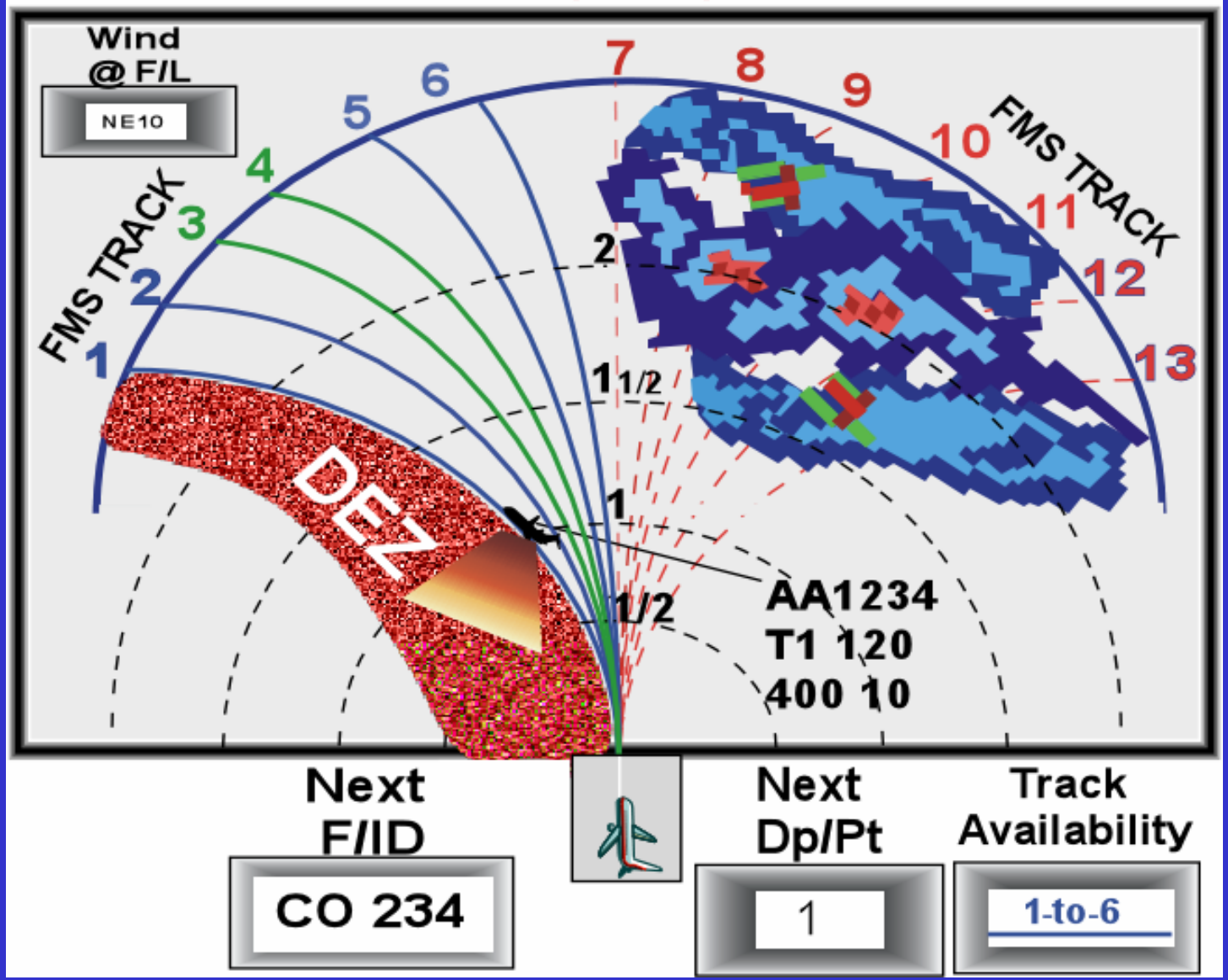


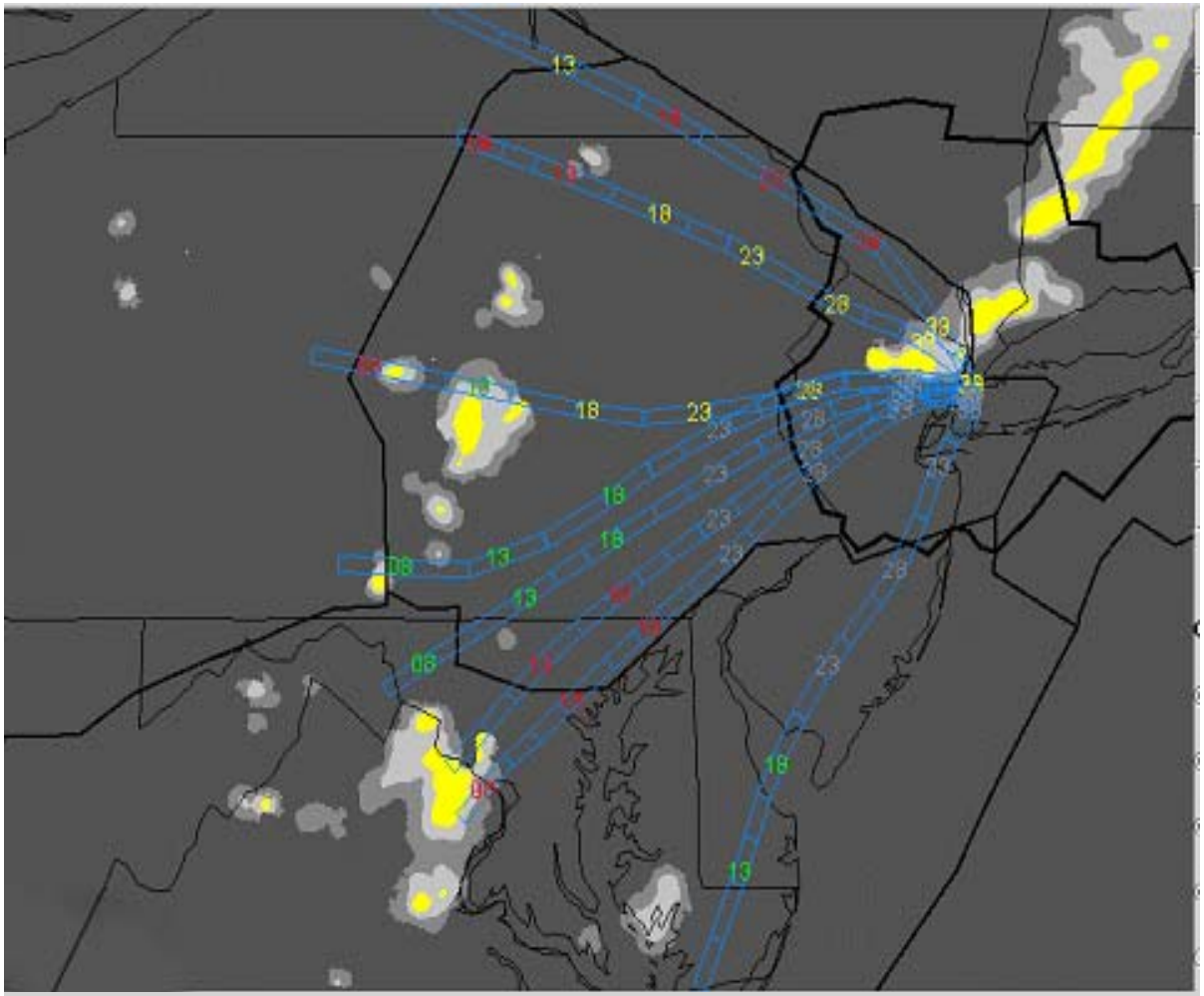
Departure Benefits

Metric	*Benefit*
Airline Op Cost	$13.5M/year
Passenger Time	$11.75M/year
Departure Capacity	10%; 5 ac/rwy/hr


Wind
@ F/L
NE10
FMS TRACK
1
2
3
4
5
6
7
8
9
10
11
12
13
FMS TRACK
AA1234
T1 180
700 2.0
DEZ
DEZ
.5
1
1.5
2
CO234
T2 115
400 1.0
Next
F/ID
UA 345
Next
Dp/Pt
1nm
Track
Availability
1-to-N

Departure Enhancement Tool (DET)





Departure Time

Route	1748	1753	1758	1803	1808	1813	1818	1823	1828	1833	1838	1843
LGA GAYEL J95	83	75	75	62	43	42	64	64	64	46	46	
LGA COATE J36	74	80	80	77	77	66	43	50	48	52	53	54
LGA ELIOT J60	31	32	48	70	70	37	52	52	52			
LGA ELIOT J80	14	14	14	7	7	7	7					
LGA PARKE J6	5	4	2	1	0	0	0					
LGA LANNA J48	8	49	52	70	71	77	77					
LGA BIGGY J75	0	2	36	70	70	99	99					
LGA WHITE J209	0	0	0	0	0	0	0					

Route Availability Planning Tool

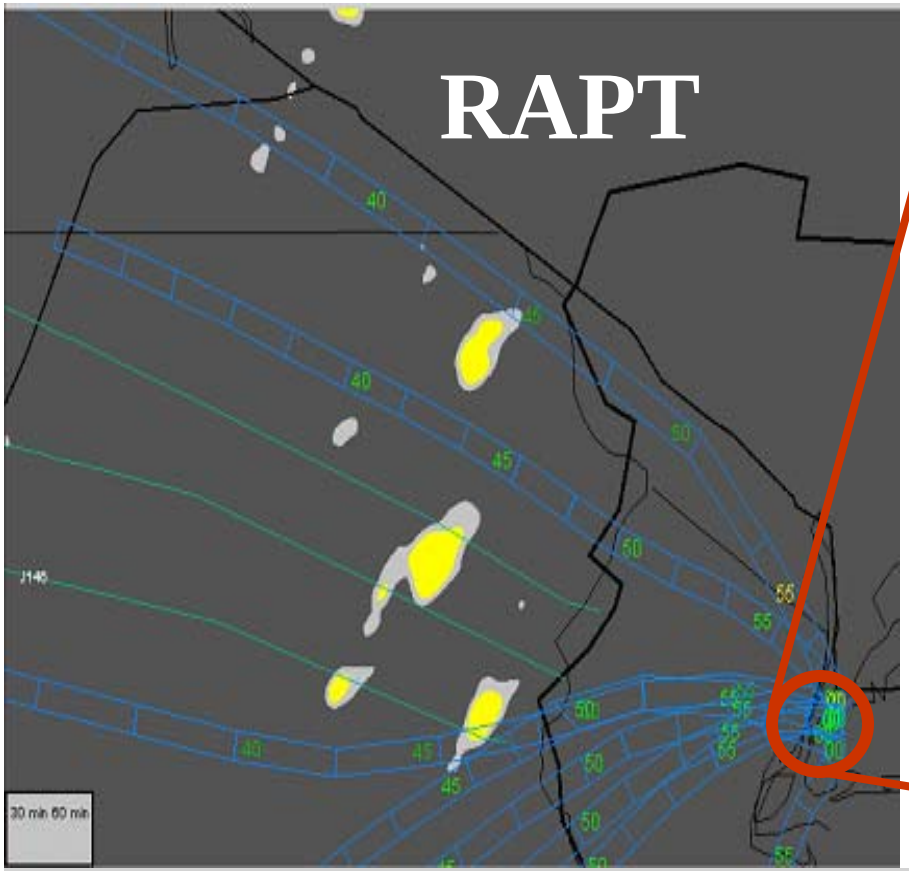
(RAPT)

RAPT is a pathfinder (during Weather conditions) forecast Route Status for every 5 minutes up to 1hr. and can also be adapt to view for sector overload conditions.

Status colors: **CLEAR**, **PTL CLEAR**, **IMPACT**, **BLOCK**

RAPT showed J80, J6 and J209 route are available able to push departures

Terminal Capacity Enhancement



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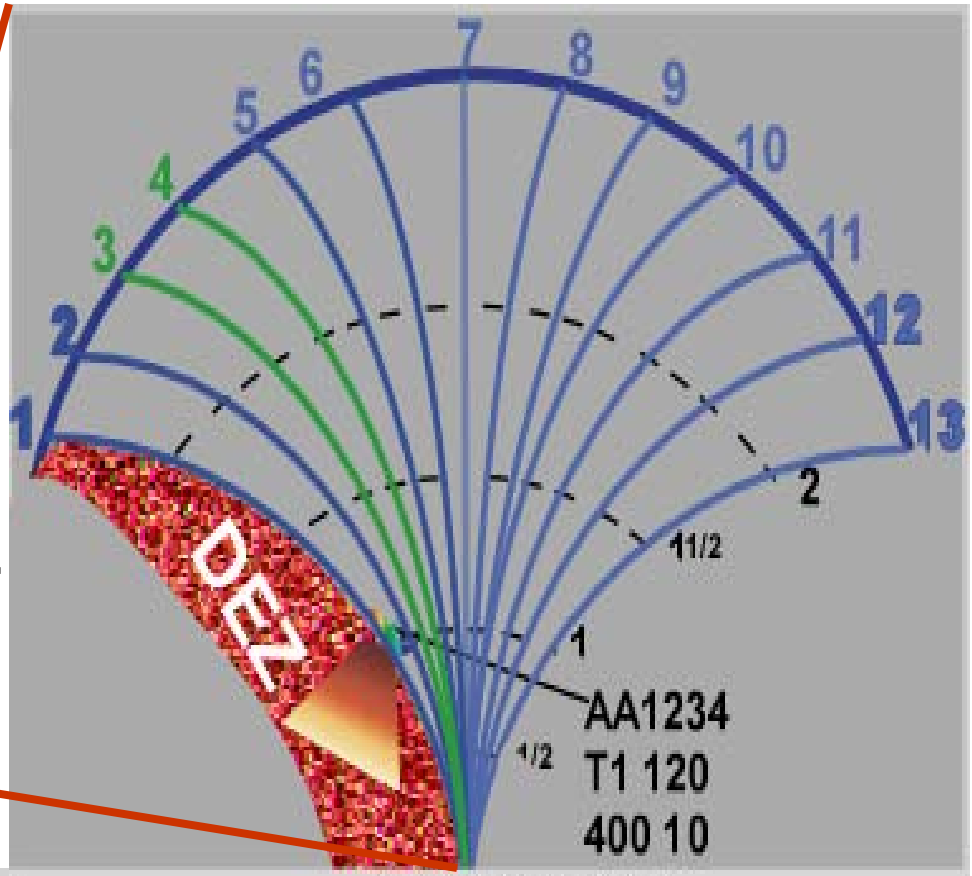

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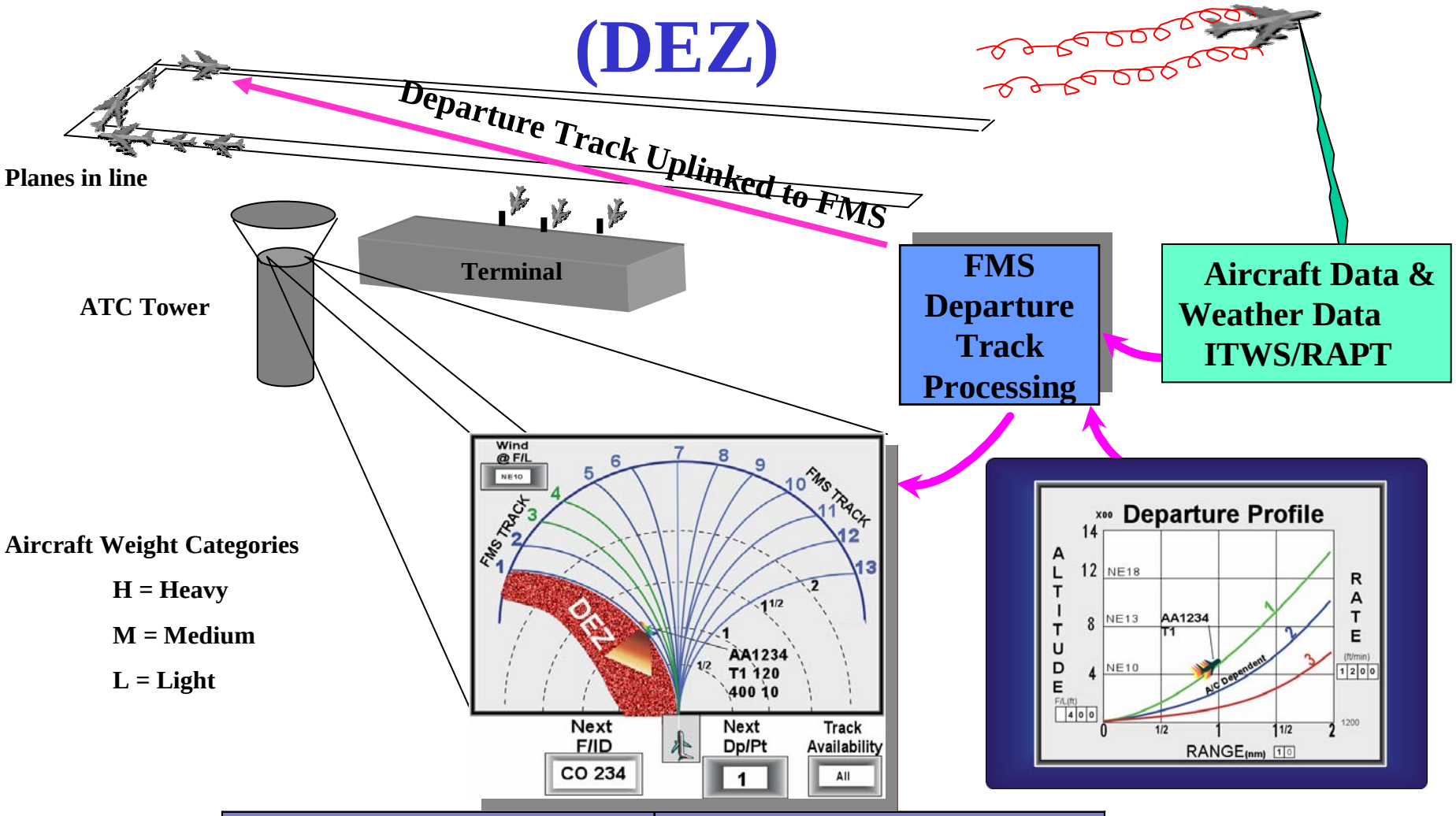
LGA COATE J36	74	80	80	77	77	68	43	50	48	52	53	54
LGA ELIOT J60	31	32	48	70	70	37	52	52	52			
LGA ELIOT J80	14	14	14	7	7	7	7					
LGA PARKE J6	5	4	2	1	0	0	0					
LGA LANNA J48	8	49	52	70	71	77	77					
LGA BIGGY J75	0	2	36	70	70	99	99					
LGA WHITE J209	0	0	0	0	0	0	0					

FMS DEPARTURE TRACK

ROUTE	TRACK 1 LO	TRACK 1 MD	TRACK 1 HY	TRACK 2 LO	TRACK 2 MD	TRACK 2 HY	TRACK 3 LO	TRACK 3 MD	TRACK 3 HY	LO
LGA GAYEL J95										
LGA COATE J36										
LGA ELIOT J60										
LGA ELIOT J80										
LGA PARKE J6										
LGA LANNA J48										
LGA BIGGY J75										
LGA WHITE J209										

Departure Exclusion Zone (DEZ)

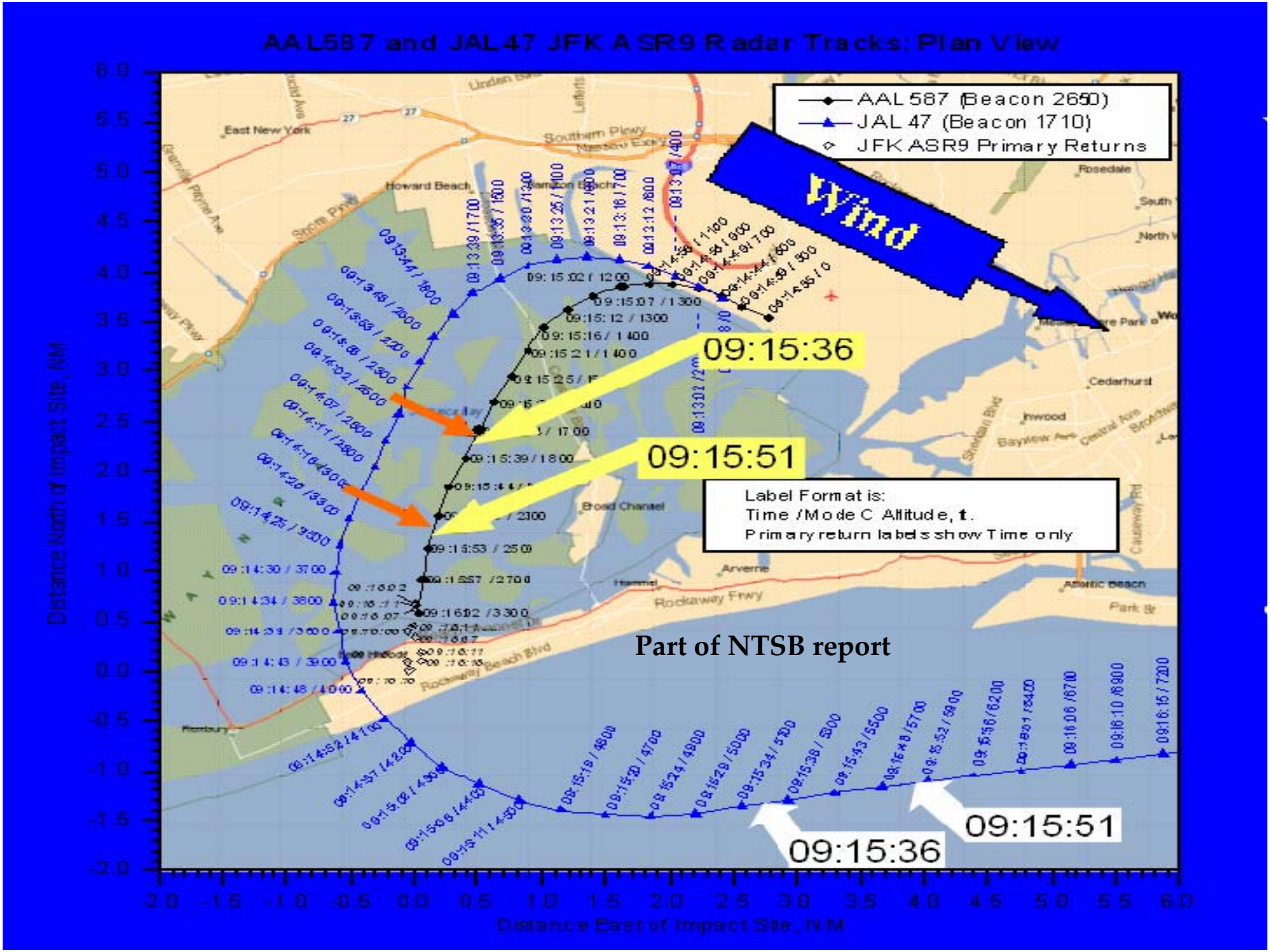


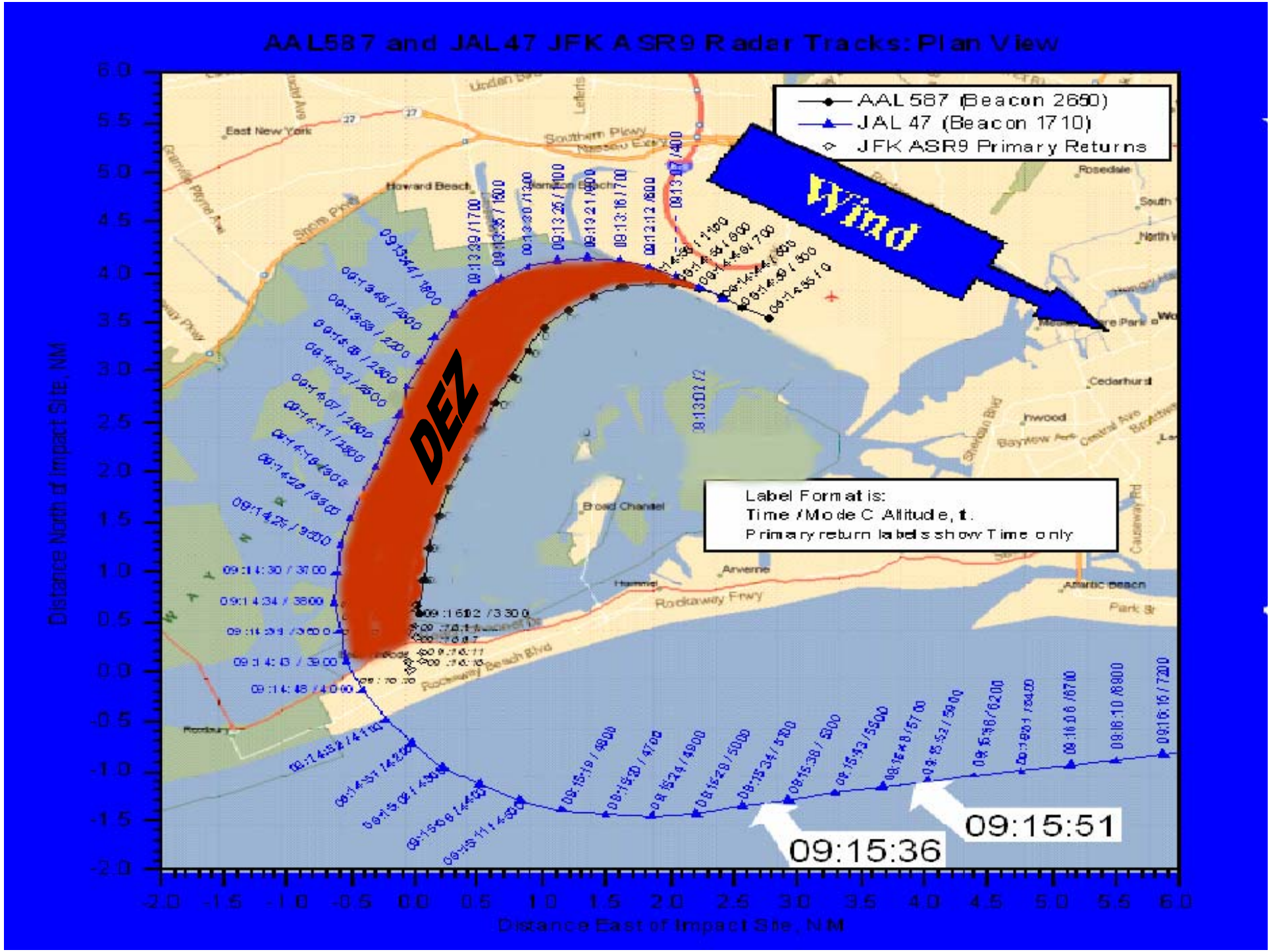
Aircraft Weight Categories

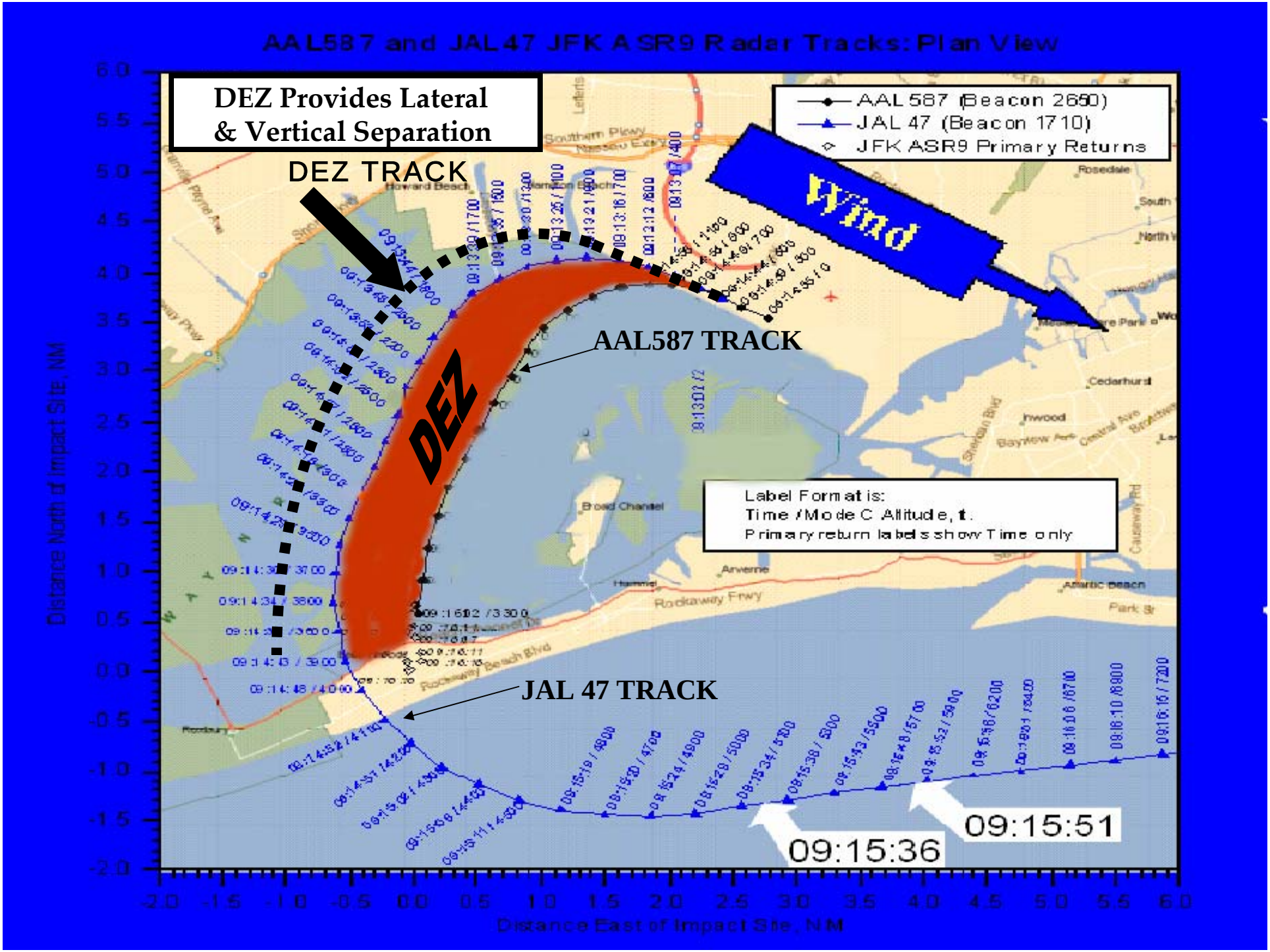
- **H = Heavy**
- **M = Medium**
- **L = Light**

Metric	*Benefit*
Airline Operating Cost	**$13.5M/year**
Passenger Time	**$11.75M/year**
Departure Capacity	**10% increase; 5 ac/rwy/hr**

CP


AAL587 and JAL47 JFK ASR9 Radar Tracks: Plan View
AAL 587 (Beacon 2650)
JAL 47 (Beacon 1710)
JFK ASR9 Primary Returns
Wind
09:15:36
09:15:51
Label Format is:
Time /Mode C Altitude, t.
Primary return labels show Time only
Part of NTSB report
09:15:36
09:15:51
Distance North of Impact Site, NM
Distance East of Impact Site, NM


AAL587 and JAL47 JFK ASR9 Radar Tracks: Plan View
AAL587 (Beacon 2660)
JAL 47 (Beacon 1710)
JFK ASR9 Primary Returns
Wind
DEZ
Label Format is:
Time / Mode C Altitude, ft.
Primary return labels show Time only
09:15:36
09:15:51
Distance North of Impact Site, NM
Distance East of Impact Site, NM
East New York
Howard Beach
Broad Channel
Rockaway Frwy
Rockaway Beach Blvd
Arverne
Atlantic Beach
Cedarhurst
Rosedale


AAL587 and JAL47 JFK ASR9 Radar Tracks: Plan View
DEZ Provides Lateral & Vertical Separation
DEZ TRACK
AAL587 (Beacon 2660)
JAL 47 (Beacon 1710)
JFK ASR9 Primary Returns
Wind
DEZ
AAL587 TRACK
JAL 47 TRACK
Label Format is:
Time / Mode C Altitude, ft.
Primary return labels show Time only
09:15:36
09:15:51
Distance North of Impact Site, NM
Distance East of Impact Site, NM

Summary

- Enhancing Airport Capacity is an Important Goal
- Wake Vortex is an Inhibiting Factor in Reaching this Goal
- Increasing Departure Rate by One Aircraft Every 15 Minutes Reduces Queuing Delays by 42%
- Increasing Departure Rates Can Be Accomplished with Extended DAP